ICGC services provisioning to scientific & professional communities

Anna M. Baron
Geodesy Department
Outline

- The ICGC
  - Geodetic Infrastructure

- CatNet network
  - CatNet infrastructure and services
  - Network monitoring
  - International Activities

- Positioning services
  - Review
  - Activity Map and usage statistics
  - New formats for positioning services
  - New uses of the services
The ICGC

- The *Institut Cartografic i Geològic de Catalunya* (ICGC) is:
  - The Mapping Agency of Catalonia
  - Responsible for the production of all official cartography at any scale
  - Responsible for provide access to the official reference frame in Catalonia.

- Mandate that is accomplished by SPGIC: Integrated Geodetic Positioning System in Catalonia.
  - Objective: To allow the positioning over Catalonia
  - Tools: Geodetic Networks
  - Resources: Geodetic Support elements
ICGC - SPGIC

- Geodetic Networks in Catalonia
  - Classical geodetic network
ICGC - SPGIC

- Geodetic Networks in Catalonia
  - Classical geodetic network
    - 3D network

4302 Survey Marks

- 69 REGENTE Network
- 681 ROI Network
- 3621 Utilitary Network (XU)

Precision 4cm (1σ)
ICGC - SPGIC

- Geodetic Networks in Catalonia
  - Classical geodetic network
    - XU network
  - XdA leveling network

Total distance levelled: 2539 Km

- 1612 Km REDNAP
- 928 Km XdA

Ellipsoidal Height at 465 points in REDNAP
ICGC - SPGIC

- Geodetic Networks in Catalonia
  - Classical geodetic network
    - XU network
    - XdA leveling network
  - GNSS permanent network
CATNET infrastructure
CATNET infrastructure

EBRE CREU AVEL BELL ESCO GARR Mata Reus Sbar Sori Cass Llei Sona Beud

GNSS Excellence Week 2016
CATNET infrastructure

- CATNET Network deployment


- GNSS capability

CATNET infrastructure

- 16 stations
  - 11 Geodynamic
    - E BRE
    - ESCO
    - LLIV
    - CREU
    - BELL
  - AVEL
  - SORG
  - CASE
  - PLAN
  - GARR
  - BEUD
- 5 Densification for RTK services
  - LLEI
  - REUS
  - MARE
  - SONA
  - SBAR

GNSS Excellence Week 2016
21st-Jan-2016
CATNET infrastructure

- 16 stations (5 EUREF & 1 IGS)
  - 11 Geodynamic
    - EBRE
    - ESCO
    - LLIV
    - CREU
    - BELL
  - AVEL
  - SORG
  - CASE
  - PLAN
  - GARR
  - BEUD

- 5 Densification for RTK services
  - LLEI
  - REUS
  - SONA
  - SBAR
  - MARE
CATNET infrastructure
CATNET infrastructure

- 16 stations
  - 11 Geodynamic
  - 6 also seismic stations

- Ebre
- Escoda
- Llivia
- Creu
- Bell
- Avel
- Sorg
- Case
- Plan
- Garr
- Beud
CATNET infrastructure

- Infrastructure at remote station:
  - GNSS Antenna/receiver
  - Seismic sensor
  - Communication devices (VSAT)
CATNET infrastructure

- Network communications:

- HUB Site:
**Terrestrial data links**

**WIMAX:**

Rural Internet

Radio Links for Data Services

256 KB - 4MB

Flexible Installation, low cost wrt satellite.

Line of sight required
CATNET Network monitoring

- Sniffing ➔ PRTG
CATNET International activities: EUREF & IGS
ICGC in EUREF

- EUREF – IAG subcomission in charge of ETR89 maintenance. Access to ETRS89 is done through EPN (246 GNSS stations network).

- EPN is a densification of the IGS global network, used to maintain the ITRF reference frames.

- These networks are also used for scientific application: land deformations, mean sea level, climatic changes, weather forecast…
EUREF LAC & DAC

- What is a LAC?
  - LAC: Local Analysis Center
  - 17 currently working
  - Systematic data analysis
  - Daily computation of precise coordinates for all the stations (in 70-90 stations subnetworks)
  - Delivered to “EUREF Coordinator Centre”, who computes the final and official coordinates.

- What is a DAC?
  - DAC: Dedicated Analysis Center
  - As a result of the reorganization of LACs, DACs are going to be focused in specific problems.
  - Computation and systematic data analysis for EPN and other stations.
ICGC role as a DAC

- Daily process computation of 156 stations.
- Automatic procedures for downloading, computing and publishing the information.
- Fulfillment of international recommendations, coming from EUREF and IGS.
- Use of Bernese software for processing and different tools for results dissemination.
Reference frame monitoring

- Precise Geodetic applications:
  - Computation and monitoring of the reference frame
  - Testing new models (MF, loading tides)

- Maintenance monitoring
  - Hardware replacement
  - Trees pruning
  - FW updating
Reference frame monitoring

- Precise Geodetic applications:
  - Computation and monitoring of the reference frame
  - Testing new models (MF, loading tides)
- Maintenance monitoring:
  - Hardware replacement
  - Trees pruning
  - FW updating
ICGC capabilities and services

- **Capabilities as a DAC:**
  - Calculation and monitoring of the TRF reference frames
  - Analysis of network coordinates stability
  - Computation of velocity fields (>2 years of data)
  - Monitoring of terrain deformation and tectonic movements

- **New services coming:**
  - High precision PPP services
  - GNSS stations Monitoring
  - Scientific and academic collaborations
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  - Activity Map and usage statistics
  - Formats for positioning services
  - New uses of the services
## ICGC positioning services

- **Post-processing**
  - **GeoFons**: RINEX files & tools aux data (geoid, coordinates, etc). FTP
  - **CatNet web**: RINEX files & tools (sat tracking, iono). HTTP

- **Real Time**

<table>
<thead>
<tr>
<th></th>
<th>Precision</th>
<th>Correction</th>
<th>Service</th>
</tr>
</thead>
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<td>Code</td>
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<td>Code</td>
<td>Interactive</td>
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### RTK service formats

<table>
<thead>
<tr>
<th>TYPE OF OBSERVATION</th>
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<th>MOUNTPOINT</th>
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<td>DGPS CODCATE</td>
<td>RTCM 2.3</td>
<td>VRS_DGPS</td>
</tr>
</tbody>
</table>
Post-processing format: RINEX 3.x

- The format can be adapted to new signals and constellations
- RINEX v3 is more readable (observables in a tabular pattern)

- GNSS industry gives support to the adoption of RINEX 3.0x
CATNET infrastructure

- CATNET Network deployment

EBRE CREU AVEL BELL ESCO LLIV PLAN GARR MATA REUS SBAR SORI CASS LLEI SONA BEUD BELL: GPS+GLONASS PLAN: GPS+GLONASS GPS+GLONASS+GALILEO for all stations

- Positioning services

RASANT DGPS CODCAT RTKAT - RTCM 2.3 RTKAT – RTCM 3.0 RASANT DGPS CODCAT RTKAT - RTCM 2.3 RTKAT – RTCM 3.0 RTKAT- CMR + DAC
ICGC positioning services
CATNET Network monitoring

- Redundancy
  - Caster duplicated
  - Processor duplicated
Activity map and usage statistics

Key Performance Indicators (PKI)

- Quantitative indicators:
  - Amount of data downloaded by user
  - Usage time of services by user
  - Number of active users of services
  - Number of new registered users

- Qualitative indicators:
  - Geographical distribution
  - Analysis of use regarding the soil type where the use of service takes place
Data Volume

- **Data Volume**

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<tr>
<th>Year</th>
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<th>RTKAT (Mbytes)</th>
<th>RINEX (Mbytes)</th>
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- **Variation respect previous year**

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Time of service

- Hours of service

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- Variation respect previous year

<table>
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Active users

### Users per year

<table>
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<tr>
<th>Year</th>
<th>CODI</th>
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<th>RINEX</th>
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<tbody>
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<tr>
<td>2006</td>
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New registered users

- **New registrations per year**

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<th>Active users</th>
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- **Variation respect previous year**

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<tr>
<th>Year</th>
<th>New users (Δ%)</th>
<th>Active users (Δ%)</th>
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<td>2007</td>
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<td>2015</td>
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## Availability of RINEX files

- **Hourly Rinex at 1 second**
- **Daily Rinex at 30 seconds**

### Availability of daily RINEX files at 30s (% epochs)

<table>
<thead>
<tr>
<th>100%</th>
<th>&lt;100% i =&gt;90%</th>
<th>&lt;90% i &gt;0%</th>
<th>0%</th>
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</table>

![Graph showing availability of RINEX files over multiple months from 2010 to 2015.](image-url)
Activity map

Activity for period 2009 - 2015

Activity 2013

Activity 2014

Activity 2015
Uses of the services: Harbours
Harbour
New uses of the services

- Precision farming
New uses of the services

- Precision farming
Airports
Airports
Water Infrastructures

CANAL SEGARRA - GARRIGUES

Legend:
- Activitat any 2012 - 1 semestre
- Activitat any 2011
- Activitat any 2010
- Activitat any 2009

0 4,000 m
Agriculture delimitation

CONCENTRACIÓ PARCEL-LÀRIA - CASTELLDANS
Extractive
Open mines

PEDRERA D’EN JOVER
Batimetry
Gas Pipelines

GASODUCTE MARTORELL-FIGUERES

Activitat any 2012 - 1er semestre
Activitat any 2011
Activitat any 2010
Activitat any 2009

0 5000 m
Highways
Regional roads
High Speed Trains
Thank you for your attention

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Fax (+34) 93 567 15 67